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MAINTAINING THE QUALITY OF BULK POTATOES SHIPPED BY RAIL FROM THE RED RIVER VALLEY IN WINTER

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MAINTAINING THE QUALITY OF BULK POTATOES SHIPPED BY RAIL FROM THE RED RIVER VALLEY IN WINTER

by Donald E. Hudson, research horticulturist
Market Quality Research Division
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SUMMARY

These tests of methods of shipping bulk potatoes by rail were made to compare the influence of method of shipping on the maintenance of quality of chipping and table stock potatoes when shipped bulk by rail from the Red River Valley, North Dakota and Minnesota, in the winter of 1969.

Although outside air temperatures were low at loading and often below freezing during transit, generally, all types of cars tested maintained potatoes at moderate temperatures. Temperature variations in the loads ranged from 5° to 14° F. Temperatures were lowest in the bottom of the RS cars, indicating that air circulation should be improved. Fluctuations in the temperature of conditioned (50° to 66° F.) chipping potatoes while in transit caused a change in quality as determined by chip color. It was concluded that the less fluctuation in temperature from that of the conditioned potatoes, the less detrimental is the change in chip color.

When the temperature of chipping potatoes was maintained near that at which they were conditioned, chipping quality improved in transit. Decay losses in transit and grade defects and culls increased as a result of improper handling during loading and unloading.

The tests showed that the quality of bulk shipped potatoes can be maintained or improved during rail shipment, even in extremely cold weather. Also in shipments of conditioned chipping potatoes, thermostats on the cars and heaters should be set to maintain load temperature as near as possible to the temperature of potatoes going into the cars. Careful handling would reduce the incidence of damage caused by bruising.

BACKGROUND

About one-third of all potatoes shipped by rail from the Red River Valley of North Dakota and Minnesota are shipped in bulk. In 1969, over 3 million hundredweight were shipped in bulk, and the amount increases annually. The change to bulk shipping has increased in load capacity, in reduced labor requirements, and in some instances, reduced tuber damage (11), (13).[1]

During part of the shipping season, potatoes are transported in extremely cold weather and are loaded when temperatures are as low as −15° to −20° F. Reduction in grade, loss of condition, wide ranges of temperature in the cars, and excessive losses from decay in transit have been reported by shippers and receivers.

Two new types of railcars are being tested to replace the RS or standard ice bunker refrigerator car, which is no longer being built. The new cars are mechanically refrigerated and heated and have two to three times the load capacity of the RS cars. New equipment for loading and unloading these cars is also being developed.

The studies reported here were undertaken to evaluate the new concepts in bulk shipping potatoes.

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[1] Underscored numbers in parentheses refer to Bibliography, p. 13.

METHODS AND MATERIALS

CAR DESCRIPTIONS

RS bulk car

The standard ice bunker refrigerator (RS) bulk cars used in these tests were equipped with air circulating fans driven by the car wheels when the car was moving. The number of thermostatically controlled heaters used in the car depended on the outside air temperature in transit. The car floors sloped at an angle of 12 to 15 degrees toward a draper chain conveyor in the center of the car. The chain conveyor extended from the ice bunkers at each end of the car to a cross conveyor trough at the center of the doorway.

Conditionaire bulk car

The center flow Conditionaire (ACF)[2] bulk potato car, is basically a covered hopper car with 3 compartments (fig. 1). Each compartment has a full-length hatch at the top (fig. 1) and a gravity flow outlet at the bottom (fig. 2). A sliding gate at each outlet opens lengthwise and allows potatoes to flow onto a conveyor directly beneath the outlet. The exterior of the car is insulated with 2 inches of polyurethane foam. A self-contained, diesel-electric generator system provides 230 volts to power the heating and cooling equipment. The equipment has 5 stages of heating and cooling, including an intermediate stage that provides air circulation during periods when the thermostat is satisfied. Also, a rapid heat-up provision is included. Air forced through the load from ducts at the bottom of each compartment is automatically maintained at a set temperature between 35° and 70° F.

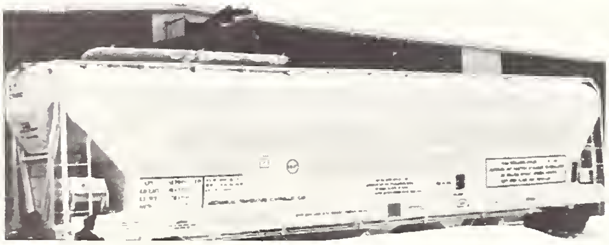

Figure 1.–The 3-compartment, covered hopper, Conditionaire car capable of hauling 183,000 lb. of potatoes.

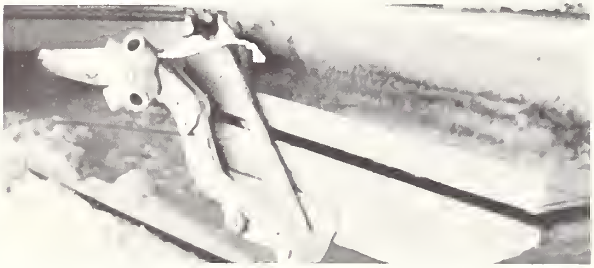

Figure 2.–Outlet gate opens to allow gravity flow of potatoes from each compartment of the Conditionaire car.

Mechanical refrigerator bulk car

The mechanical refrigerator car used in these tests was converted for bulk shipping of potatoes by replacing the floor racks with a slatted floor that sloped toward a draper chain conveyor extending from each end of the car to a cross conveyor trough in the doorway on the side of the car. The walls, roof, and floor have a 6-inch foamed-in-place insulation core. Ducts at the sidewalls and air diffusers from a plenum above the ceiling aid in air circulation. A diesel-electric generator system provides 220 volts to automatically power the heating and cooling equipment. A 5-stage control provided a high and low setting each for heating and cooling and an intermediate setting for air circulation only as required to hold the desired thermostat setting. Temperature could be controlled between 0° and 70° F.

SAMPLING PROCEDURES

A sampling procedure was devised for taking potatoes at random off both the loading and unloading conveyor as follows: 200 tubers per 60,000 lb. load from the RS bulk car; 400 tubers per 120,000 lb. load from the mechanical refrigerator bulk car; and 600 tubers per 183,000 lb. load from the ACF car.

TUBER DAMAGE AND DISEASE DETERMINATIONS

Tuber injury was determined by a combination of chemical and visual analysis, with a catechol solution containing 30 g. of pyro-catechol per gallon of water as the indicator (9). Every fifth tuber from each sample was immersed in the catechol solution for 10 minutes and allowed to dry before being visually rated for bruising. Injured areas turned dark red to black after tubers were treated with catechol. Discoloration was found in any fresh injury in which the periderm was broken. The extent of damage shown by catechol-treated tubers was rated as follows: slight, less than 5 percent of the surface area damaged; moderate, 5 to 10 percent of the surface area damaged; and severe, more than 10 percent of the surface area damaged.

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[2] Built by ACF Industries.

The remainder of each sample was used to determine the incidence of rots and internal blackspot at loading and unloading.

TEMPERATURE RECORDING

Tuber temperature at both loading and unloading was determined with metal pulp thermometers which were used on 10 to 30 potatoes taken at random from the conveyors.

Ryan recording thermometers were used in the RS bulk potato cars to record temperatures at points throughout the car (fig. 3, *A*). A list in the appendix (page 13) gives the coding and location of each thermometer. Figure 3, *B* shows a thermometer being placed in a load of potatoes.

In the Conditionaire and mechanical refrigerator cars both thermometers and thermocouples were used to record temperatures. A 24-point Brown Electronik recorder was used in conjunction with the thermocouples. The list in the appendix gives the coding and location of the points where temperatures were recorded in these cars. The points at which temperatures were recorded in each of these cars is shown in figure 4. A potato with a thermocouple wire attached is shown before being placed in position in the mechanical refrigerator car (fig. 5).

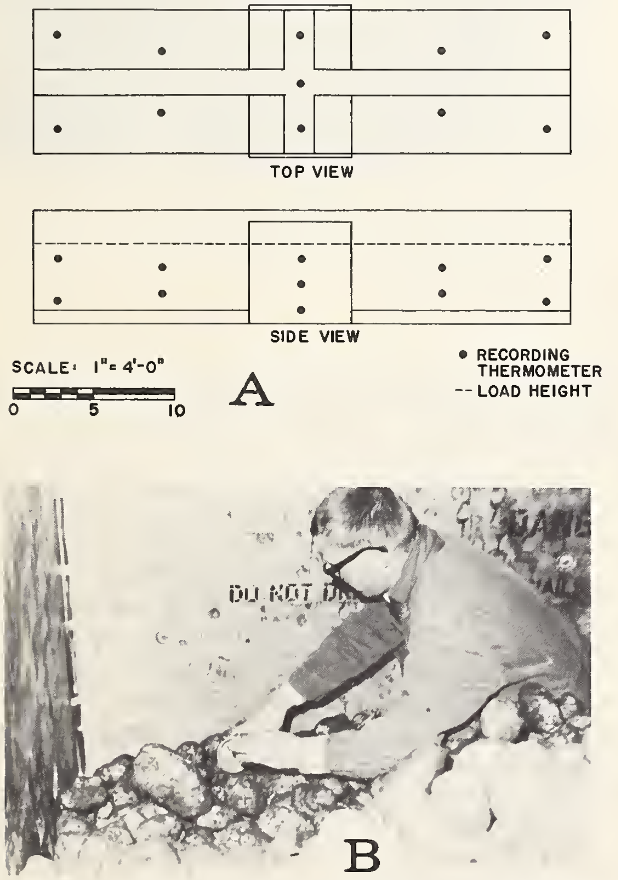

Figure 3.—*A*, Points showing the locations of recording thermometers in the RS bulk potato cars; and *B*, recording thermometer being positioned in a load of potatoes.

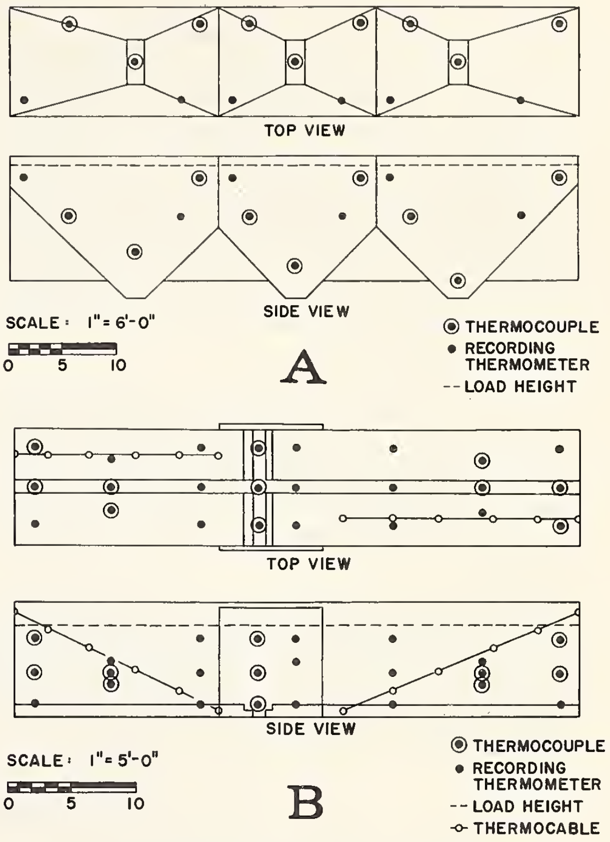

Figure 4.—Points showing locations of recording thermometers and thermocouples *A*, in the Conditionaire car; and *B*, in the mechanical refrigerator car.

Figure 5.—A potato with a thermocouple attached ready for positioning in a load of potatoes in the mechanical refrigerator car.

Ryan recording thermometers were also attached to the underside of each car to record outside temperature.

SHIPPING ARRANGEMENT OF CARS

Four of the cars were set up as single car tests. In all other test shipments cars were paired either as RS to RS car, Conditionaire to RS car, or mechanical refrigerator car to RS car, so that comparisons could be made of the effectiveness of the different types of cars in maintaining the temperature and quality of the potatoes. The paired cars were loaded with potatoes from the same storage and shipped to the same destination on the same train. When possible the paired cars were loaded the same day. However, in tests with the Conditionaire car, loading time was usually 7 to 8 hours; and the paired RS car was loaded on a different day.

In two test shipments with the mechanical refrigerator car and one with the Conditionaire car, equipment was placed in the load so that air samples could be drawn at intervals. These samples were then analyzed for oxygen and carbon dioxide content with an Orsat-type gas analyzer.

Where possible random samples of potatoes were taken during loading and unloading of each test car and checked for chip color to determine any change in quality, as shown by chip color, which might occur during transit.

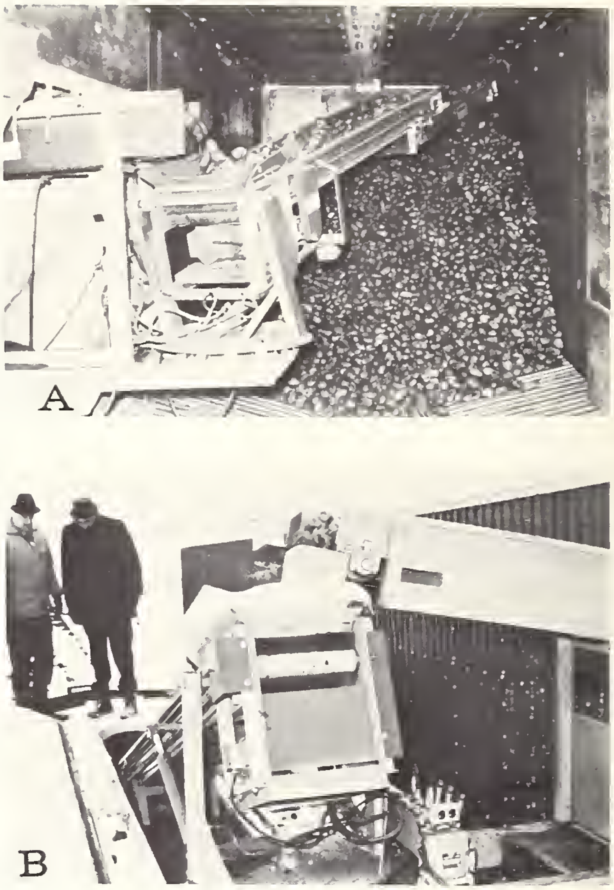

Figure 6.—The types of conveyors used to load *A*, the mechanical refrigerator car and the RS bulk car; and *B*, the Conditionaire car.

LOADING AND UNLOADING THE CARS

To load the RS bulk car and the mechanical refrigerator car potatoes were conveyed from the grading table to a telescoping loading conveyor at the door on the side of the car. The conveyor extended into the car and could be directed toward either end. Figure 6, *A* shows potatoes being loaded into one end of the mechanical refrigerator car. Filling began in one end with the conveyor lowered to within 6 inches of the floor. As the car filled, the conveyor was raised and directed from one side of the car to the other and gradually retracted to give a uniform fill. When one end of the car was filled the conveyor was directed to the other end and the process was repeated. The center of the car was filled last as the conveyor was backed out the door.

When the RS and the mechanical cars were ready to be unloaded, the doors were opened, and a conveyor was inserted in the cross conveyor trough. Then the first pick-out board was removed from over the cross conveyor to start the flow of potatoes. The potatoes were conveyed to a pallet box loader which raised automatically as the pallet boxes were filled.

To load the Conditionaire car, potatoes were conveyed from the grading table to a conveyor extending out of the storage over the car hatch opening (fig. 6, *B*). The potatoes were directed onto a hydraulically controlled, telescoping conveyor which was lowered through the hatch opening to the bottom of the compartment. As loading progressed, the conveyor was raised (fig. 7). When loading was completed, the conveyor was removed, the hatch was closed, and the car was moved to position the next compartment beneath the conveyor.

At unloading, the insulated gate cover shown in figure 2 was unlatched and swung to one side. A belt conveyor was moved into position between the track and the gate.

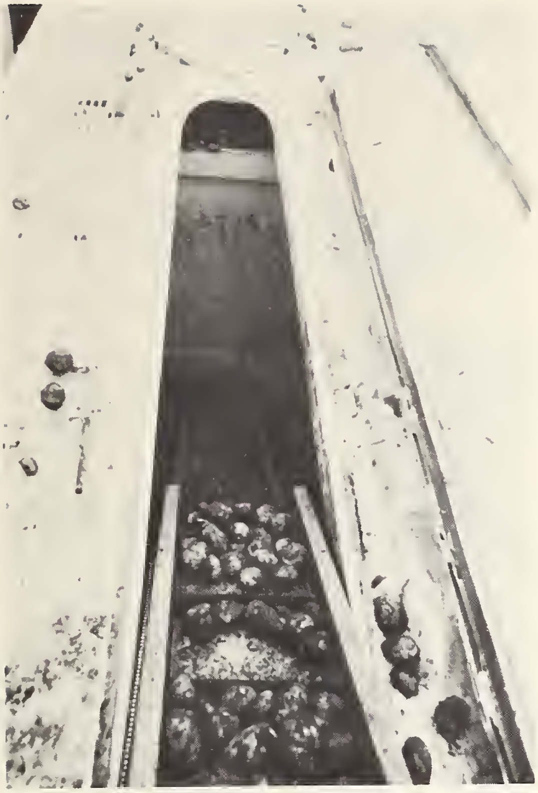

Figure 7.—Loading potatoes into a compartment of the Conditionaire car by a hydraulically controlled, telescoping conveyor.

A capstan was swung out, locked into position, and turned with an iron bar to open the sliding gate. The potatoes were then conveyed to a pallet box filler and loaded into pallet boxes.

RESULTS AND DISCUSSION

In the RS cars, chipping potatoes were shipped under *Rule 580* of Perishable Protective Tariff 18 and its supplements issued by the National Perishable Freight Committee (8) whereby the shippers specified the temperature setting of the cars' thermostats. In the Conditionaire and mechanical refrigerator cars both chipping and table stock potatoes were shipped under *Rule 710* whereby the shippers specified the optimum temperatures desired in transit. The table stock shipments in RS cars were shipped under *Carriers' Protective Service*, which specified that the carrier will protect the shipment from freezing or artificial overheating.

Generally, in all of the cars tested, the temperature in the cars and quality of the potatoes were satisfactorily maintained in transit. However, differences did exist (see table 1). Temperatures at certain points inside some cars were low, and quality of potatoes as determined by chip color varied considerably from that of potatoes in the other car paired in the same test.

SHIPMENTS OF CHIPPING POTATOES

In a paired car shipment of chipping potatoes going to River Grove, Ill., the increases in temperature change after the third day indicated that either heater control, air circulation, or both, in the car were poor (fig. 8, *A*). A drop in minimum temperature to the low 50's in the bottom of the load and a rise in maximum temperature to or near 70° F. indicates that poor air circulation did exist. Quality as determined by chip color improved during transit. Internal blackspot, which was negligible at loading, was found in 13 percent of the tubers examined at unloading. This increase could be attributed to rough handling during loading operations.

In tests pairing the Conditionaire with a RS car, the range between the maximum and minimum temperatures was the same (6° F.). However, there was less total change in the temperature of potatoes in the Conditionaire car (fig. 8, *B* and *C*).

TABLE 1.- -Average temperatures in bulk shipment tests of late-crop potatoes from the Red River Valley, Minnesota and North Dakota, January 8 to April 3, 1969

Stock type and test car No.	Date shipped	Type of car[1]	Thermostat setting	Destination	Tuber temp. at loading	Outside air temp. at loading	Average temperature in transit				Tuber temp. at unloading
							Top layer	Middle layer	Bottom layer	Outside air	
Chip stock:			°F.		°F.	°F.	°F.	°F.	°F.	°F.	°F.
1........	Jan. 9	RS	60	River Grove, Ill.	64	-10	68	65	62	9	60
2........	Jan. 8	RS	60	do.	66	4	67	65	64	11	57
3........	Jan. 14	RS	60	Irving, Tex.	57	28	64	64	64	27	62
4........	Jan. 15	ACF	60	do.	57	24	61	61	63	28	61
5........	Jan. 16	ACF	60	Houston, Tex.	57	8	62	62	62	46	61
6........	Feb. 10	RS	60	do.	53	8	67	- -	64	34	68
7........	Feb. 11	ACF	60	do.	53	18	59	61	64	25	61
8........	Feb. 13	RS	60	Dallas, Tex.	65	8	67	65	62	33	59
9........	Feb. 13	Mech.	60	Dallas, Tex.	64	-14	67	64	67	21	61
10........	Mar. 6	RS	60	San Jose, Calif.	50	9	59	65	56	25	60
11........	Mar. 6	Mech.	60	do.	51	11	62	62	63	25	60
12........	Apr. 3	Mech.	60	Wichita, Kan.	58	24	64	63	63	49	63
Table stock:											
13........	Jan. 14	RS	40	Garland, Tex.	39	28	42	42	40	31	48
14........	Feb. 8	RS	40	Burlington, Iowa	42	-8	42	42	37	14	[2] 56
15........	Feb. 8	RS	40	do.	43	-8	44	45	41	14	46
16........	Mar. 19	ACF	45	Garland, Tex.	40	21	47	49	48	39	46
17........	Mar. 28	Mech.	50	do.	43	30	51	50	50	33	- -

[1] RS is standard ice bunker refrigerator bulk car; ACF is center flow Conditionaire bulk car; and Mech. is mechanical refrigerator bulk car.

[2] This car was held 3 weeks before it was unloaded because low temperatures in transit indicated the possibility of frozen tubers in the load and time was allowed for these to break down.

In three paired car tests of Conditionaire to RS cars of chipping potatoes during the period from January 15 to February 21, 1969, the RS car temperatures averaged higher than the thermostat setting whereas the temperatures in the Conditionaire cars averaged very close to the thermostat setting (fig. 9). Comparing the total change in tuber temperature from loading to unloading, the temperatures in the Conditionaire car remained closer to the original tuber temperature than the temperatures in the RS cars did. Less change in temperature in the Conditionaire cars apparently proved beneficial to quality as determined by chip color. The color intensity of chips from potatoes in the RS cars had an average light intensity 6 percent darker than the chips from potatoes in the Conditionaire car. The greater difference in temperature change may have brought about a new chemical balance in the potatoes which affected chip color. Such a condition has been suggested by Burton (3) who states that changes in temperature cause a new chemical balance in potatoes. This change in the chemical as well as in the physiological balance could cause the color difference.

The temperatures involved in tests pairing the mechanical refrigerator car with the RS bulk cars are shown in figures 10, and 11). In the earlier test with the mechanical refrigerator car and the RS car there was less total change in tuber temperature in the mechanical car (see table 1), and the average temperature did not drop as low in the mechanical cars as it did in the RS car. In the second test shipment involving the mechanical and RS cars (fig. 10, *B*) there was a wider range of temperatures throughout the test in the RS car than occurred in the first mechanical-RS car test (fig. 10, *A*). Figure 11 also indicates that there was less total change in temperature in the mechanical refrigerator cars than in the accompanying RS cars. Chip color was lighter by an average intensity of 3 percent from potatoes shipped in the mechanical cars than it was from potatoes shipped in the RS bulk cars. In all shipping tests except one, chip color improved in transit. However, the improvement of

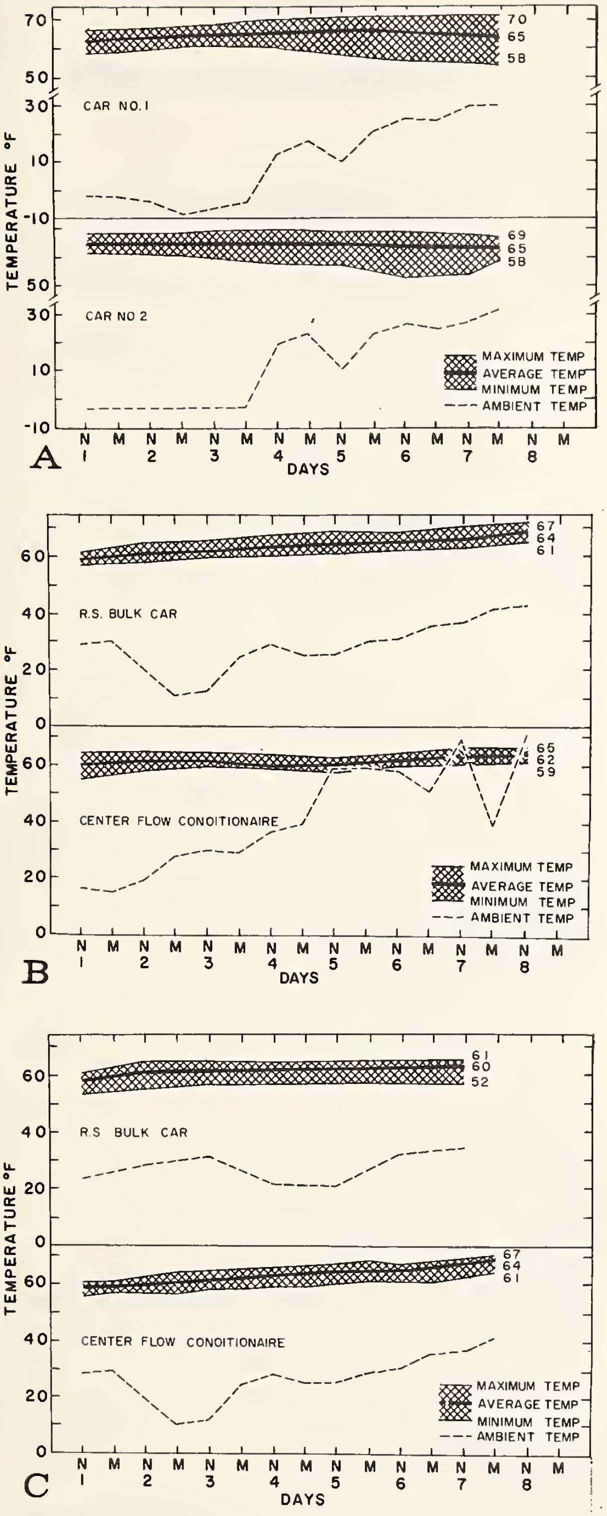

Figure 8.—Temperature patterns in *A*, a RS to RS paired car test of chipping potatoes shipped January 9, 1969 to River Grove, Ill.; *B*, in a Conditionaire to a RS paired car test of chipping potatoes shipped January 16, 1969, to Houston, Tex.; and *C*, in a Conditionaire to a RS paired car test of chipping potatoes shipped January 15, 1969, to Irving, Tex.

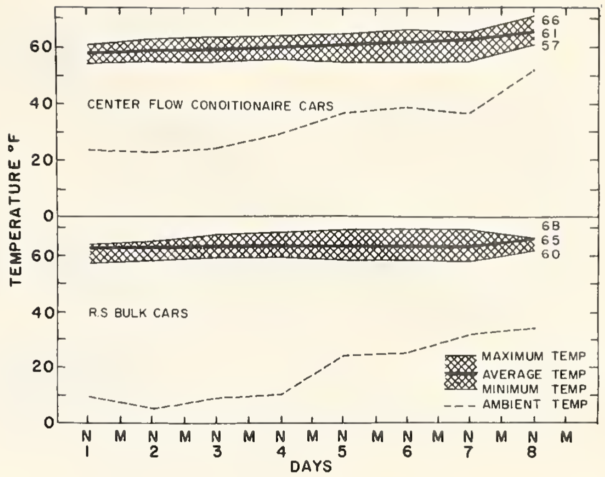

Figure 9.—Temperature patterns in the 3 paired car tests of Conditionaire to RS cars going to Houston and Irving, Tex., from January 15 to February 11, 1969.

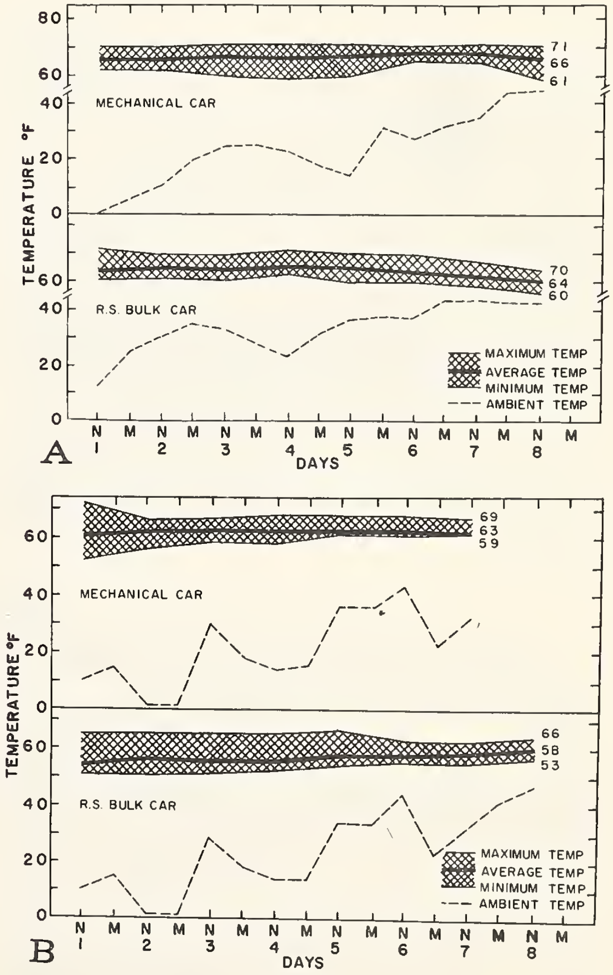

Figure 10.—Temperature patterns in a mechanical refrigerator to RS paired bulk car test of chipping potatoes *A*, shipped February 13, 1969 to Dallas, Tex.; and *B*, shipped March 6, 1969 to San Jose, Calif.

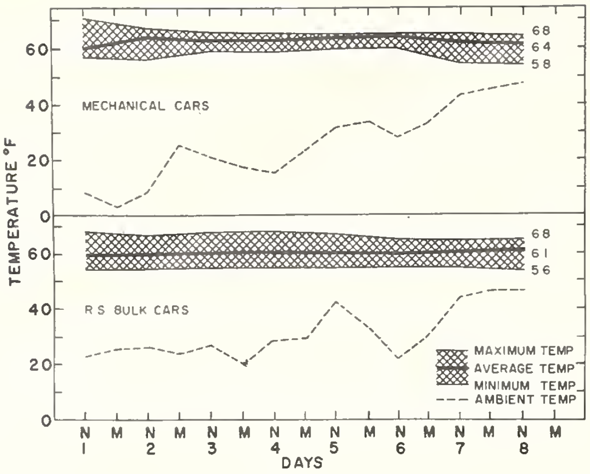

Figure 11.—Temperatures in the paired car tests involving mechanical refrigerator cars to RS cars from February 13, to March 14, 1969.

color was greater in the mechanical and Conditionaire cars than in the RS-type cars. The one car in which chip color was darker at destination than at the shipping point was a RS bulk car.

Lack of proper or sufficient ventilation in the mechanical cars was shown by the build up of carbon dioxide and reduction of oxygen in transit. In the second test shipment in the mechanical car (to San Jose, Calif.) carbon dioxide increased to 11.5 percent and the oxygen was reduced to 7.5 percent in a 6-day period. In the second shipment (to Wichita, Kans.) where oxygen and carbon dioxide were determined in transit in the mechanical refrigerator car, carbon dioxide increased to 14.9 percent in 12 days. In the latter shipment the high carbon dioxide content was believed to be responsible for the increased amount of soft rot decay found at destination.

SHIPMENTS OF TABLE STOCK POTATOES

With the exception of one test car which had low temperatures and some freezing in transit to Burlington, Iowa, temperatures of table stock potatoes (fig. 12) were maintained well in all bulk cars. As indicated in figure 12 the minimum variation in temperature during transit was in the Conditionaire car. The RS car had a narrower range of temperatures than the mechanical car. The wider range in the mechanical car probably resulted from the outside temperature extremes during transit.

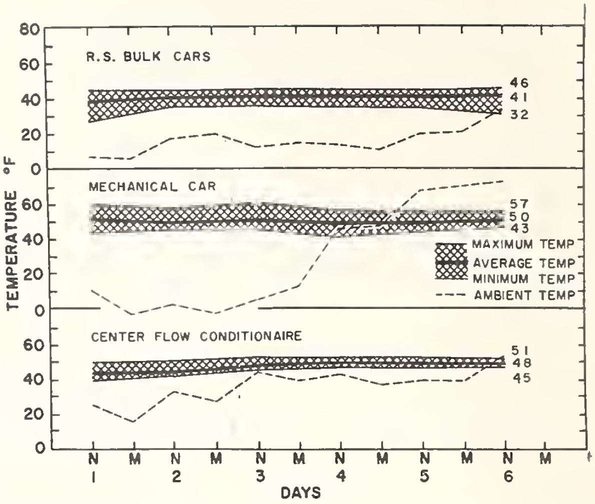

Figure 12.—The temperature patterns in table stock potatoes shipped bulk by rail from the Red River Valley to Burlington, Iowa, and Garland, Tex., February 8 to March 27, 1969.

Quality of the potatoes upon arrival of the mechanical car was indicated by more than 90 percent packout of U.S. No. 1's at destination. The atmosphere of the Conditionaire car was sampled periodically en route, and the maximum build up of carbon dioxide was found to be 1 percent. This was less than Stewart and others (12) found in earlier tests of table stock shipped in mechanically refrigerated box cars and was far less than was found in shipments of chipping potatoes in the mechanically refrigerated box cars.

TUBER BRUISING AND DISEASE DEVELOPMENT

Bruising was serious while potatoes were being handled during loading and unloading. The catechol test for fresh bruising indicated that severe bruising averaged 16 percent during loading and 15 percent during unloading. This bruising is not accumulative because catechol indicates only freshly damaged tubers before suberization begins. Although disease development in transit was minor in these tests, excessive tuber damage that occurred during loading could be responsible for the increased disease losses in transit. Also, damage that occurred during both loading and unloading increased grade defects and culls found during terminal packing operations.

Internal black spot, which averaged 2.6 percent when the cars were loaded, had increased significantly to a 5.7 percent average at destination.

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APPENDIX

The following list gives the coding and location of recording thermometers in the standard ice bunker refrigerator bulk cars.

Code	Location
ALBQ	"A" end of car, left side, bottom quarter of load, 1.5′ from wall, 1.5′ from bunker, 3.0′ from ceiling.
ALBQ$_1$	"A" end of car, left side, bottom quarter of load. 2.5′ from wall, 8.0′ from bunker, 5.1′ from ceiling
ARTQ	"A" end of car, right side, top quarter of load. 1.5′ from wall, 1.5′ from bunker, 3.0′ from ceiling
ARTQ$_1$	"A" end of car, right side, top quarter of load. 2.5′ from wall, 8.0′ from bunker, 3.5′ from ceiling
CLCP	Center of load, center point of the car
LDBQ	Left door, bottom quarter of load. 1.5′ from wall, 6.5′ from ceiling

RDTQ	Right door, top quarter of load. 1.5′ from wall, 3.0′ from ceiling
BLTQ	"B" end of car, left side, top quarter of load. 1.5′ from wall, 1.5′ from bunker, 5.6′ from ceiling
BLTQ$_3$	"B" end of car, left side, top quarter of load. 2.5′ from wall, 8.0′ from bunker, 5.1′ from ceiling
BRBQ	"B" end of car, right side, bottom quarter of load. 1.5′ from wall, 1.5′ from bunker, 3.0′ from ceiling
BRBQ$_3$	"B" end of car, right side, bottom quarter of load. 2.5′ from wall, 8.0′ from bunker, 3.5′ from ceiling

The following list gives the coding and location of recording thermometers and thermocouples in the Center Flow Conditionaire bulk cars.

Code	Location
AGBQ	"A" end of car, bottom quarter of load. 4.5′ above the unloading gate
ALMQ$_2$	"A" end of car, left side, middle of load. Midway between the unloading gate and the corner of the car
ALTQ	"A" end of car, left side, top quarter of load. 1.5′ from wall, 17.0′ from the AC compartment divider, 11.0′ from bottom of load
ARTQ	"A" end of car, right side, top quarter of load. 1.5′ from wall, 1.5′ from the AC compartment divider, 11.0′ from bottom of load
ARMQ$_2$	"A" end of car, right side, middle of load. Midway between the unloading gate and the corner of the car
CGBQ	Center compartment, bottom quarter of load. 3.0′ above the unloading gate
CLMQ$_2$	Center of compartment, left side, middle of load. Midway between the unloading gate and the corner of the car
CLTQ	Center of compartment, left side, top quarter of load. 1.5′ from wall, 1.5′ from the AC compartment divider, 11.0′ from bottom of load
CRMQ$_2$	Center compartment, right side, middle of load. Midway between unloading gate and the corner of AC compartment divider
CRTQ	Center compartment, right side, top quarter of load. 1.5′ from wall, 1.5′ from BC compartment divider, 11.0′ from bottom of load
BGBQ	"B" end of car, bottom quarter of load. 1.5′ above the unloading gate
BRMQ$_2$	"B" end of car, right side, middle of load. Midway between the unloading gate and the corner of the BC compartment divider
BLMQ$_2$	"B" end of car, left side, middle of load. Midway between the unloading gate and the corner of the car
BLTQ	"B" end of car, left side, top quarter of load. 1.5′ from the BC compartment divider, 11.0′ from bottom of load
BRTQ	"B" end of car, top quarter of load. 1.5′ from wall, 17.0′ from BC compartment divider, 11.0′ from bottom of load

The following list gives the coding and location of recording thermometers and thermocouples in the converted mechanical refrigerator cars.

Code	Location
ACCL	"A" end of car, center of car, center of load. 3.5′ from wall, 14.5′ from end, 5.3′ from ceiling
ACML	"A" end of car, center of car, center of load. 3.5′ from wall, 7.3′ from end, 5.3′ from ceiling
ACMQ	"A" end of car, center of car, middle quarter. 3.5′ from wall, 1.5′ from end, 5.3′ from ceiling

ALBQ	"A" end of car, left side, bottom quarter of load. 1.5′ from wall, 1.5′ from end, 8.0′ from ceiling
ALBQ$_1$	"A" end of car, left side, bottom quarter of load. 2.5′ from wall, 7.3′ from end, 6.1′ from ceiling
ALTQ	"A" end of car, left side, top quarter of load. 1.5′ from wall, 14.5′ from end, 2.7′ from ceiling
ARBQ	"A" end of car, right side, bottom quarter of load. 1.5′ from wall, 14.5′ from end, 8.0′ from ceiling
ARTQ	"A" end of car, right side, top quarter of load. 1.5′ from wall, 1.5′ from end, 2.7′ from ceiling
ARTQ$_1$	"A" end of car, right side, top quarter of load. 2.5′ from wall, 7.3′ from end, 4.5′ from ceiling
CLCP	Center point of car, center of load. 3.5′ from wall, 22.0′ from end, 4.3′ from ceiling
LDBQ	Left door, bottom quarter of load. 1.5′ from wall, 19.0′ from end, 8.0′ from ceiling
LSBQ	Left side, bottom quarter of load. 1.5′ from wall, 22.0′ from end, 8.0′ from ceiling
RSTQ	Right side, top quarter of load. 1.5′ from wall, 22.0′ from end, 2.3′ from ceiling
BCCL	"B" end of car, center of car, center of load. 3.5′ from wall, 14.5′ from end, 5.3′ from ceiling
BCML	"B" end of car, center of car, middle of load. 3.5′ from wall, 7.3′ from end, 5.3′ from ceiling
BCMQ	"B" end of car, center of car, middle quarter. 3.5′ from wall, 1.5′ from end, 5.3′ from ceiling
BLBQ	"B" end of car, left side, bottom quarter of load. 1.5′ from wall, 14.5′ from end, 8.0′ from ceiling
BLTQ	"B" end of car, left side, top quarter of load. 1.5′ from wall, 1.5′ from end, 2.7′ from ceiling
BLTQ$_3$	"B" end of car, left side, top quarter of load. 2.5′ from wall, 7.3′ from end, 4.5′ from ceiling
BRBQ	"B" end of car, right side, bottom quarter of load. 1.5′ from wall, 1.5′ from end, 8.0′ from ceiling
BRBQ$_3$	"B" end of car, right side, bottom quarter of load. 2.5′ from wall, 7.3′ from end, 6.1′ from ceiling
BRTQ	"B" end of car, right side, top quarter of load. 1.5′ from wall, 14.5′ from end, 2.7′ from ceiling
RDTQ	Right door, top quarter of load. 1.5′ from wall, 19.0′ from end, 2.7′ from ceiling
RDCL	Right door, center of load. 4.5′ from wall, 19.0′ from end, 5.3′ from ceiling

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